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ABSTRACT

This report provides information concerning the five goals of the Burroughs B20 microcomputer project in the College of Education at the University of Nevada-Reno: (1) to improve the computer literacy of classroom teachers and increase their general awareness of developing computer technology; (2) to enhance student writing across curricula; (3) to conduct evaluations of educational software; (4) to utilize computer technology to aid departmental advisement of students; and (5) to develop and fieldtest reading and phonetics software to support testing and diagnosis of students with reading and/or learning disabilities. The teacher training computer literacy project for both pre- and inservice students centered on the development of curriculum materials for teaching computer literacy, a history of computing, types of educational software, and courseware evaluation. The word processing project investigated how word processing might help motivate otherwise reluctant writers in middle and high schools toward a more animated sense of interaction with the texts they create. The courseware evaluation component focused on the development of a software evaluation form, and the student advisement and screening study identified required input and desired output for a program to be developed to aid in the advisement of elementary, secondary, and special education students at the college. Finally, the reading and phonetics project resulted in the development of a diagnostic program to determine students' knowledge of word structure. A list of 13 references is provided. (Author/JB)

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The Utilization of Burroughs Microcomputers in Teacher Training

Final Report COE 86-1
College of Education
University of Nevada-Reno
Reno, Nevada 89557

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The Utilization of Burroughs Microcomputers in Teacher Training
Final Report COE 86-1
University of Nevada-Reno
College of Education
Reno, Nevada 89557
April 7, 1986

This final report is respectfully submitted to the Burroughs Corporation. It has been developed to provide information concerning the utilization of microcomputers in five areas related to teacher training: computer literacy, word processing, courseware evaluation, student advisement and screening, and reading and phonetics. It is the result of a microcomputer gift from the Burroughs Corporation which speaks to Burroughs' interest in the improvement of the quality of higher education in teachers' college institutions.

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Abstract

This report provides information concerning the five goals of the Burroughs B20 microcomputer project in the College of Education at the University of Nevada-Reno: (1) to improve computer literacy and increase general awareness of developing computer technology, (2) to enhance student writing across curricula, (3) to conduct evaluations of educational software, (4) to utilize computer technology to aid departmental advisement of students, and (5) to develop and field-test reading and phonetics software supporting testing and diagnosis of students with reading and/or learning disabilities. The teacher training/computer literacy project centered on the development of curriculum materials for teaching computer literacy, a history of computing, types of educational software, and software/courseware evaluation to preservice and inservice students. The word processing project investigated how word processing might help motivate otherwise reluctant writers (in public middle and high schools) toward a more animated sense of interaction with the texts that they create. The courseware evaluation component focused upon the development of a software evaluation form that would include the following criteria: content, hardware requirements, design, ease of use, record keeping and management, program strengths and weaknesses, validation, user comments, target audience and cost. The student advisement and screening study identified required input and desired output for a program to be developed to aid the advisement of elementary, secondary and special education students at the College. Finally, the reading and phonetics project resulted in the development of a diagnostic program to determine students' knowledge of word structure.

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Introduction

Technological change is advancing and affecting not only society on the whole but education as well. If we were to draw a continuum for national teacher acceptance of change, higher education would be found on the lower end of this spectrum because of lack of instructional dollars to support innovative change using technology and various attitudes of acceptance on the part of faculties and administration. A few years ago, Johnson, Anderson, Hansen, and Klassen (1981, p. 14) stated that the widespread availability and impact of microprocessor technology in the home, school, and the world of work had made it imperative for schools to incorporate the opportunity for pupils to develop an understanding of microcomputer technology as well as the capability to deal with the introduction of high technology in the school. This trend has continued, and youth have been among the first to embrace the new technology and see its possible applications. Their acceptance of computer technology as an important aspect of our information society has led educators to realize that there might be imperative reasons why the computer should be used in teaching. Teachers should now see the merits of curricular change embracing technology, for either older faculties will modernize, or the next generation (which will likely possess a higher level of acquired microcomputer skills) will modernize educational institutions. Therefore, it is indeed a very fortunate set of circumstances when an educational institution (a) has a nucleus of faculty interested in exploring how microcomputer technology may be utilized to facilitate instruction and thereby benefit students preparing for professional roles as teachers and (b) finds a microcomputer corporation interested in providing technological assistance in helping such teachers-to-be prepare for the microcomputer age. Obviously, the integration of microcomputers into and across the educational spectrum is of keen importance (Bonham, 1983), and it is of major interest to teachers college institutions, which must keep abreast of technological development and its impact on ways in which students learn.

Microcomputer Literacy

All students should have the opportunity to use the microcomputer in school curricula and to develop skills in both utilizing software and in operating and controlling the microcomputer. These opportunities should occur across the curricula and not be limited to only one academic area. The growing use of information technology creates new opportunities and challenges for society and in particular education. The acquisition of basic microcomputer competencies is of increasing importance to all students for success in an information society. "Microcomputer literacy" involves the ability and skill to operate a microcomputer and be able to find appropriate uses for it, and it can be taught through a variety of courses. Students will need a full range of skills, knowledge, understanding, values and relationships in order to function in a technological world and to cope with the inevitable changes that will occur. Students need to be able to use the microcomputer as a tool with which they can work and increase their knowledge in many curricular areas which are appropriate to their specific needs and aptitudes in the school. In addition, they should also develop proficiency in using commercially developed software. They may be given the opportunity to develop facility in the areas of information retrieval, spreadsheets, word processing, and telecommunications. Moreover, they should be able to create, store, and retrieve personal files by using a commercial data based program, and they should be able to create, manipulate and make projections by using a spreadsheet program. This is why applications such as Multiplan and DataManager (used with Burroughs B21 and B25 microcomputers) are of such value. Likewise, a word processing program (in this case WriteOne) is useful in teaching students how to create, edit, format, store, retrieve and print text.

Educational goals related to providing microcomputer literacy with Burroughs microcomputers in schools should include the following:

1. Improve computer literacy
2. Increase general awareness of developing technology

3. Emphasize creative problem solving
4. Conduct a general evaluation of courseware/software
5. Improve writing across the curriculum

The first of these goals can enhance the educational process by helping students to learn how to operate Burroughs B20 and B25 microcomputers and access multiple data bases rapidly and effectively using Multiplan and DataManager. The second relates to the importance of becoming aware of new information technology as it becomes available, evaluating this technology and utilizing it. The third is an important element of modifying many college courses to emphasize creative problem solving rather than the memorization of information. Microcomputer software could be utilized to aid instruction in this area. The fourth faces the need for evaluating the entire range of microcomputer courseware/software. It could be extended to include hardware evaluation as well as an assessment of courseware/software. The last goal has implications for the entire curriculum, for it would hopefully spread across curricula and help realize instructional goals in a variety of subjects and disciplines.

How we utilize technology to improve learning and retention is a key to the positive use of technology in schools. In the area of providing opportunities for pupil learning, for example, the communication channel between microcomputer program, teacher and pupils is important since the microcomputer may be used as a means of managing teaching and demonstrating difficult concepts to be learned (Fraser, 1981).

Information Technology and Curricular Innovation

To a very large extent, the microcomputer revolution has been a "bottom-up" revolution resulting from public acceptance of the microcomputer as a very necessary part of the fabric of our society. For curricular change to have any significance, teachers must be convinced of the positive, lasting effects of microcomputer utilization. Microcomputers will continue to occupy an increasingly important position

as an educational delivery system, and they will become increasingly integrated into mainstream instructional activities.

There will also be a growing emphasis upon integrating microcomputers into curricula. Standards for quality in educational software will become more widely accepted and applied. Teachers may become so motivated and convinced of the value of microcomputers that they will become "movers" in utilizing microcomputers in curricula, utilizing identifiable courseware as well as recommending microcomputer utilization to colleagues. These persons may be so involved in microcomputer education that they will become facilitators of the new technology. School principals, for example, have already discovered this inasmuch as they frequently delegate responsibilities to committed teachers to manage the details of microcomputer implementation policies within their schools (Shavelson, Winkler, Stasz, and Robyn, 1983).

Scanland and Slattery (1983, p. 12) suggest that teachers should reexamine "their personal philosophy of the teaching/learning experience, the nature of the teaching role, national and educational long-range goals, and present teacher/student outcomes of the educational process."

In the larger context of curriculum development, several key principles relating to curriculum change have been identified by the Rand Corporation (Berman and McLaughlin, 1978). Findings of that study which have a bearing upon microcomputer utilization include the following:

1. Teachers often represent the best clinical expertise available in terms of their knowledge about the practice of teaching.
2. In a sense, teachers need to "reinvent the wheel" each time curriculum change is brought to or generated within the context of the school.
3. Professional learning is a long-term, non-linear process.
4. Staff development should be seen as an on-going part of the school program improvement process.

Additional staff, staff training, sufficient software and hardware, and appropriate facilities are essential to the implementation of computer education. Training should

be available for all teachers in the use of computers for instruction and management of information. Since the trend has been to move away from using computers solely for programming to using computers as tools in various applications, it is essential that consistent district-wide procedures exist within school districts for the selection, purchase, and maintenance of software and hardware because a continuing effort should be made to incorporate the usage of microcomputers wherever they are relevant to the curriculum.

Implications

The success of a model of collegiate cooperation must inevitably rest upon the willingness of individuals to accept innovation and the need for curricular change. Interest in microcomputer technology and curriculum development must be stimulated across disciplinary boundaries in a way that will encourage participants to see the importance of this technology in their own subject areas or disciplines.

Demonstrating the importance of the microcomputer to a particular subject or discipline is no easy matter. A positive method that has had good results would be to find other faculty in the same discipline who are already using micros and/or have insights worth sharing. These insights might relate to perceptions of how the computer may be a unique and appropriate instructional tool for their fields. Again, the use of teams of faculty might lead to team-building and acquisition of skills leading to curricular revision and innovation.

Organizational design of instruction utilizing the computer will lead to curricular redesign. Curricular growth will accompany microcomputer utilization and the development of computer literacy. Curricular innovation is a team effort, but frequently only a few committed individuals stimulate the introduction and use of microcomputers in instruction. If microcomputer education is to affect a larger part of the curriculum, a team approach must be employed, and a goal of universities and

colleges must be the preparation of better teachers who can apply technology in innovative and creative ways. Educators must address this specific goal, but doing so will mean that they must look at what constitutes good teaching and how it may be enhanced through the application of educational technology and software.

Project Goals

The University of Nevada-Reno's continuing research efforts are directed at developing instructional programs embracing software applications and improving teacher training. Its computer project addressed the problems cited in the National Commission on Excellence in Education Report (1983)—"A Nation At Risk"—related to the quality of teachers, because there was a growing awareness that educational institutions were not meeting student and national needs, particularly with respect to computer-based education. If computer technology is to find its rightful place in education, it must be perceived as a structurally integrated part of teaching. The focus of UNR's project was to reduce the gap which exists between teaching and the use of technology in the preparation of classroom teachers at teachers colleges. A hope of project participants was that better educated teachers would be produced through the utilization and application of Burroughs equipment and future instructional programs. Five goals of the project were (1) to improve teacher training/computer literacy in higher education, (2) to improve student writing across curricula in colleges of education and arts and science, (3) to conduct evaluations of educational software using DataManager (a Burroughs data management program), (4) to develop a student advisement form with DataManager for departmental advisement of students in higher education, and (5) to produce a valid diagnostic program in reading for students with reading and learning disabilities. The purpose of the first of these goals was to help pre-service and in-service teachers learn how to operate and utilize microcomputer technology and software effectively. The second reached across the curricula to

encompass the improvement of writing skills in many disciplines since writing is integral to instruction in a variety of subjects. The third faced the need for evaluating appropriate educational software. The fourth sought to create a useful instrument for the academic advisement of students in teachers colleges. Finally, the intent of the fifth one was to develop a rationale and structure for a diagnostic program in reading and then adapt this program for use with Burroughs B21 and B25 microcomputers. An unexpected divident was that the College of Education at the University of Nevada-Reno became a model for the Washoe County School District in illustrating the instructional and administrative capabilities of Burroughs equipment and programs in education.

Prior to the beginning of the project, very few students had used Burroughs microcomputers, although many had used other microcomputers at some time. As the project progressed, a study of 195 students at the College revealed that 95% used Burroughs computers for their coursework. Most of this coursework was related to classes such as Curriculum and Instruction 260 "Basic Computer Applications in Education," a 1-credit computer literacy course required of elementary education majors, and other newly developed computer education courses: CI 486/686 "Microcomputers in Education" (3 cr.), CI 489/689 "Microcomputer Management for School and Class" (3 cr.), and CI 490/690 "Microcomputer Courseware Design" (3 cr.).

The dominant use of Burroughs microcomputers by students during the project was word processing. Other utilizations included record keeping, accessing the mainframe computer at the university, and software development. Overall, students felt more comfortable using BASIC and WriteOne word processing. They were much less comfortable in applications of an authoring program called Author and data handling programs such as Multiplan and DataManager, which were more complex.

Progress

Progress toward project goals embraced five areas of development: teacher training/computer literacy, WriteOne word processing, data management for courseware evaluation, student advisement and screening, and a diagnostic reading program.

1. Teacher Training/Computer Literacy.— Efforts in this area centered on the development of instructional materials and software using an authoring program called Author to train computer-literate teachers. Components included a curriculum guide; computer applications; guidelines for analyzing, evaluating and selecting educational software; discussion of the history and possible future trends of computer education; recognition of educational problems that can be solved with the computer; familiarity with computer architecture; selection of appropriate hardware, software, and peripherals for academic or administrative tasks; application of computing skills to enter and retrieve information and to solve problems; and use of drill-and-practice programs, tutorials, and possible simulations.

2. WriteOne Word Processing.—

[Introduction]

There has been a remarkable transformation over the past ten years in educator's knowledge about the best practices in the teaching of writing at the kindergarten through twelfth grade levels. A transformation has come about largely through our attention to students' processes of composition in the evolution of their final written texts. There has been relatively little attention, however, to the variety of ways that work by students with word processing might be integrated into specific schools and classrooms that now use the "process" approach to the teaching of writing. Nor has there been sufficient attention to the ways that relatively early work by students with

word processing might help motivate otherwise reluctant writers toward a more animated sense of interaction with the texts that they create.

The Northern Nevada Writing Project is directly related to a national writing project, and it has trained twenty K-12 public school teachers each year for the past two years through an intensive five-week summer institute in the teaching of writing. Each of these teachers has written extensively, revised his/her own writing in collaboration with other teachers, and developed presentations on the teaching of writing, which then have been used for in-service writing workshops for other teachers throughout one-half of Nevada. What characterizes these teachers as a whole is their high level of professional commitment and competence, and their sense of excitement about what they are discovering, and helping others to discover, about the teaching of writing.

Individuals at different sites of the national writing project have worked with writing project teachers in half of Nevada in such selective uses of microcomputer word processors as interactive poetry writing, but as yet there has been no project site in the United States which has involved writing project teachers in an exploration of their students' proven classroom practices in the teaching of writing. Such a project is nationally significant, since it integrates the best of what we presently know about the teaching of writing with what we are just beginning to discover about the adaptive uses of word processors in relation to the best classroom practices in the teaching of writing.

The first step in this project was the enhancement of the writing and reading skills of seventh and eighth grade students. Two middle schools were targeted, and faculty worked intensively with selected teachers from these schools in relation to the development of their students' writing and reading skills. Two of the teachers who worked with this project were graduates of

the regional writing project's summer institute, and they worked collaboratively with graduate students in educational research at the College of Education and with the faculty coordinator of this project to develop teaching practices and materials which more effectively promoted their students' growth as writers and readers. This project was then extended to grades 9-12.

The purpose of this project has been to investigate how word processing might help motivate otherwise reluctant student writers in public middle and high schools toward a more animated sense of interaction with the texts that they create. Adaptation and modification of Burroughs' WriteOne software for middle and high school students has taken place in two middle schools and one high school which were the focus of research involving Burroughs B25 (512K, 10MB hard disk) microcomputers and WriteOne word processing software. Selected teachers at these schools were trained in the use of WriteOne through writing workshops offered by the College in conjunction with its Northern Nevada Writing Project. These teachers have in turn introduced WriteOne to students in their classes, where it is used to improve writing skills. Materials produced consisted of applications and documentation using WriteOne to develop methods for using microcomputers to enhance the teaching of writing skills. Software tutorials developed through the use of Author will continue this thrust. Finally, a teacher-developed and written guide for instructional use of WriteOne and Burroughs B25 technology by students and teachers was written and revised.

A central feature of this writing and reading project was the focus upon the role of university researchers and classroom teachers as observers of their students' behaviors as writers and readers. Teachers and researchers, working in collaboration, learned from these observations to create structured settings which further enhanced such change. A project of this sort may be called a

"best case" study, where one first tries to create a setting in which one believes that significant change in learning rate or quality will occur, then observe and describe the significant changes which do occcur, and finally use this knowledge to create further settings which promote this growth more often for more students. The central features of this type of "best case" study, as well as the necessarily tentative and exploratory nature of all such studies based on this model, are best conveyed by Calkins' (1983) well-known book called Lessons from a Child. From the observations of a "best case" setting, techniques were evolved and refined for integrating word processing activities into the writing process in the classroom on the basis of further observations about their effectiveness.

Because of the design of this study and its initial focus on individual learners working with exceptionally competent teachers, the interactions of a select group of learners were explored with the process of composing their texts when this interaction was enhanced through the use of word processing and, in particular, with a suitable adaptation of the WriteOne word processing system. Through such an exploratory, step-by-step approach to the integration of word processing into classroom practices that have already demonstrated their effectiveness in the teaching of writing, broad ranges of possible uses of word processing with middle school- and high school-age students can emerge.

The project was evaluated from a human resource and equipment standpoint using the case study method to investigate changes in the writing process per school that may occur in each teacher's classroom because of the presence of qualified teachers, the use of refined techniques, and the effective use of word processing equipment. Formative evaluations of the "best case" model which had been put forth were made at the end of each academic year

during the project. A final summative evaluation was done at the conclusion of the project. All process-product evaluations were conducted with the cooperation and participation of project teachers primarily at the middle school level and later at the high school level.

Two middle schools and one high school in the Washoe County School District were involved in the writing project. Each utilized a Burroughs B25 microcomputer and accompanying B9252 dot-matrix printer. In addition, selected teachers at these schools were shown how to use WriteOne word processing through writing workshops. These teachers in turn introduced WriteOne to students in public school classes, where it was used to improve writing skills.

[Project as Experiment]

The WriteOne Writing Project represented an experiment in merging the technology of one computer word processing program (WriteOne) with a pre-existing staff development model (the Northern Nevada Writing Project), that was already in place, and thriving, at the public school district level. Because of the double focus suggested by such a merger, this final report will include both (a) specific observations based on the field testing of the WriteOne program in two middle schools and one high school in the Washoe County School District and (b) more general comments on the degree of success of the merger as a whole.

[Results of Field Testing]

Three Burroughs B25 computers and printers were introduced to two middle schools and one high school in late November 1984. Six different teachers who were using these computers in their classrooms had all been trained in a three-day WriteOne workshop held over the previous summer. In addition, three of these same teachers were simultaneously attending a university-based research

seminar whose purpose was to observe students' composing practices as they wrote their classroom assignments on Burroughs computers.

The simplest observation that can be made about the field-testing of the WriteOne program in either middle or high school classrooms is that teachers' willingness to re-think their writing assignments and their classroom organization to accommodate student use of the computer depended directly on their degree of familiarity with the WriteOne program. The three teachers who had taken only the three-day WriteOne summer workshop (using the B21 computers in the Burroughs Computer Lab in the College of Education at the University of Nevada-Reno campus), and who then were faced with a somewhat different computer in their classroom three months later (Burroughs B25's in place of B21's), made very little use of the computer in their writing classrooms in public schools. Their reports on their experiences indicated that the cost of the computer and the complexity of its word processing program made them extremely cautious about integrating it into their classrooms, or allowing their students to experiment with and learn about the computer's word processing program on their own. However, with the three teachers who sustained and increased their familiarity with the Burroughs computers through their participation in the research seminar, field testing yielded more substantial results. One middle school English teacher restructured her critical thinking class so that every student was able to enter and revise a short text using WriteOne word processing; one high school teacher assigned four typing-proficient students in her creative writing class to do all their drafts on the word processor; and another high school teacher had students in her journalism class compose and edit a school-wide newspaper usin WriteOne.

While the results of the case studies of individual students' composing practices using the WriteOne program were limited to the four students

mentioned above in the one high school creative writing class, it was clear from the behavior of these students that their work on the computer increased their sensitivity to the dynamic, evolving nature of their texts. The project members could also envision the Burroughs B20 computers, with their unique ability to provide a rapid recapitulation of all the revisions a writer makes on a text (triggered when a session is not "successfully" completed), contributing significantly to future research on students' composing practices. For such research to yield significant findings, it would be necessary for students to spend long periods of sustained time composing their texts at a Burroughs terminal, and perhaps for those students to be proficient college-level typists. But the possibilities, the project members agreed, were tantalizing.

[Developing a Simplified User Manual for WriteOne]

The computers and printers had only been in the schools for a short time before the participants in the WriteOne writing project decided that the development of a simplified user manual for the WriteOne program ought to become one of their top priorities. In order for even the most involved teachers in the project to make adequate use of the Burroughs computers in their classrooms, they would need a way to introduce new users quickly and independently to the features and functions of the WriteOne word processing program and the LPT (line printer) print commands.

The development of such a manual took two different forms. Two members of the project developed an extensive and carefully sequenced manual for both new student users and new teacher users over the summer of 1985. These manuals were not tested in their intended field sites, due to the termination of the project's funding shortly after their completion, but they have since become the primary means through which new users of the Burroughs B21 and

B25 computers in the college's Burroughs computer lab have become familiar with WriteOne word processing.

The second form that the development of a simplified manual took was more radical. Might it be possible, the project members reasoned, to develop a single session introduction to the WriteOne program that could be used to introduce prospective and practicing teachers to the technology of word processing in relation to the "technology" of the handwritten or typewritten word? The need for such a one session introduction was based on the prior existence of academic year and summer session writing workshops, sponsored by the Northern Nevada Writing Project and the UNR College of Education, which introduced prospective and practicing teachers to a wide range of methods of utilizing writing as a tool for learning in their classrooms. Clearly an introduction to word processing as a "tool" for writing would be a vital and timely addition to these teacher training workshops, particularly since the technology of word processing lent itself so thoroughly to these workshops' emphasis on writing as an act of vision and revision. But was it possible to create such a concise introduction for WriteOne?

It has taken seven different writing workshops, taught over three semesters and two summer sessions, to begin to answer that question. And the answer at this point seems to be "Yes, provided that new users are introduced to the WriteOne program metaphorically, through connections between their experience with this program and events or contexts that they are familiar with in their daily lives." The metaphor for the experience as a whole that seems to have been most helpful to new users has been to compare entering one's user name, requesting the word processing program, and then calling up the many different functions within this program, to entering a large mansion and going to certain rooms within that mansion. This metaphor helps to remind

new users that remembering the steps one took to enter a "house" and proceed to a desired section is a necessary prerequisite to being able to leave that same "house"! Other metaphors have been devised to help new users recall sub-sections of the word processing program, but the important perception to keep in mind is that teachers will never approach the frequency of use of WriteOne or any other word processing program that typifies such desk-based professions as banking, newspaper reporting, or professional writing. Because of this, introductions to word processing programs for prospective and practicing teachers must substitute memorable analogies for the ease with word processing that comes with frequency of use. Only after teachers have become familiar with the functions and features of computer word processing in general will they begin to think creatively and substantively about ways to integrate this significant new "tool for writing" into their classrooms.

3. Data Management for Courseware Evaluation.— This effort centered about documenting and reporting teacher evaluations of software using DataManager for the collection and evaluation of software data. Information from Washoe County school teachers concerning content, hardware requirements, design, ease of use, record-keeping and management, program strengths and weaknesses, validation, user comments, target audience and cost were recorded for future teacher use in northern Nevada. A criterion referenced guide and form for evaluation were sent to selected public school teachers in the Washoe County School District. These teachers evaluated 46 elementary and secondary school courseware programs and returned completed evaluations for compilation using DataManager.

The microcomputer program that was developed to evaluate microcomputer courseware provided for opportunities to enter evaluative data from the keyboard and offered a printed report of data from two important key fields--

meeting objectives and appropriate reading level—as well as other important fields. Data could be reviewed by searching each entry individually. Only two headings were selected as key fields because DataManager has a finite number of entries for programming statements to provide information in a printed report format. Thus, the two key fields which related to concerns such as (1) whether the software/courseware met course objectives as well as the stated objectives of the materials and (2) whether the reading level of the material was appropriate.

4. Student Advisement and Screening.— Planning for this DataManager project included the identification of required input, desired output, and how the system would be used by faculty to assist the advisement and screening of elementary, secondary and special education students. In particular, advisement needs were reviewed with respect to improving the use of current advisement and screening forms at the University, and, in particular, the advisement needs of the Department of Curriculum and Instruction at the College of Education have been considered in relation to key advisement and screening forms in current use such as the Secondary Education Advisee's Manual, the Elementary/Special Education Course of Study and the Advanced Standing Admission Approval Form. Multiplan was considered as an alternative for use in student advisement. Finally, DataManager was chosen because it offered a greater number of data fields.

It is important for the College to be able to access whatever student data are available in order to (1) project course offerings based upon programmatic needs relevant to current student data, (2) survey trends among students such as differences in ACT scores, etc., (3) tabulate data pertaining to advisors and numbers of students, and (4) maintain a data file regarding teacher placement. Student data which would be helpful for these purposes would include:

Student name
Social security number
Advisor
Matriculation/graduation dates
Class: freshman, sophomore, junior, senior, or graduate
Status: (1) Undergraduate
Elementary/Special Education or Secondary
College
Major/minor
(2) Graduate
Special
Masters
Major
Cognate
Units passed
GPA - date
ACT Scores: English, math, comprehensive, social science, science, and date taken
PPST Scores: Reading, writing, math, and date taken
NTE Score: Area and date taken
GRE Score: Verbal, quantitative, advanced education, and date taken
Teacher placement information
Date, location, and position

It was intended that the advisement program would provide student information relating to courses taken and needing registration in order to complete major, minor, and credentialing requirements. The student advisement package would list "methodology" courses in the College of Education as well as "content" courses in the College of Arts and Sciences. This advisement package would then be used to provide student information related to courses taken, in progress, and needed for completion of major, minor, and credentialing requirements. DataManager was utilized to create records and advisement sheets for courses, credits, and requirements met or needing completion. However, data containing information about courses completed in the Colleges of Education and Arts and Science could not be stored over a 4-5 year period for students enrolled in college programs, because 10 MB hard disk storage space using DataManager was not large enough. Moreover, Burroughs B20's were not linked to the University of Nevada System Computing Center's

mainframe computer in this particular project since this data was not accessible to the Department.

All entries on the student advisement form were considered to be equally important. They could be reviewed by searching each entry individually. DataManager has a finite number of entries for programming statements to provide information in a printed report. For this reason, the key fields were: (1) student name, (2) social security or identification number, (3) advisor, (4) degree sought, and (5) date of expected graduation.

A second DataManager project in process is a system of record control for students enrolled in Master of Education programs. These programs require several courses which are offered intermittently due to the limited enrollment. As a result, it is difficult to schedule such courses when the required number of students are prepared to take these courses. Often eligible students are unaware of such offerings. This results in frequent delays for students completing their degrees.

This control program is limited to course completion and projection only so that the data can be stored on floppy disks which will be easily available without taking up hard disk memory space on the H20. This program will be used to (1) plan course offerings over a two-year cycle based on students' projected programs, (2) tabulate data identifying students who should be enrolled in each course, and (3) prepare mailing information for use in notifying students of the course offerings and their need to make arrangements for enrollment. Student data which will be needed for this program include:

Social Security Number
Student Name
Address
Advisor

Course No.	Completion	Projected Enrollment
CAPS 700	—	_____
CI 707	—	_____

☐ 720	—	_____
☐ 740	—	_____
☐ 742	—	_____
☐ 646	—	_____
☐ 633	—	_____
☐ 639	—	_____
☐ 640	—	_____
☐ 642	—	_____
☐ 644	—	_____
☐ 746	—	_____
☐ 771 (a-f)	—	_____
☐ 772 (a-f)	—	_____
☐ 773	—	_____

5. Diagnostic Reading Program.— Efforts in this area have centered on the development of a diagnostic program to determine students' knowledge of word structure. Two diagnostic instruments have been developed: a restructured word analysis inventory adapted for related administrative uses, and a word knowledge diagnostic program based on current research in students' orthographic and phonological knowledge. Included with this summary are copies of the summary sheets for each of the students. Written comments were made by the graduate assistant who assisted the children with the program.

While they are seated at a microcomputer, students are administered a spelling inventory, and their spellings are stored in memory and tabulated according to instructional level. This level is then further analyzed to determine error types and confirm the level at which word study may be most are considered in terms of specific categories. Stored error information is selected in view of the error that are most likely to occur at these levels. In other words, a "lexicon" of misspellings is stored in computer memory. To illustrate, common misspellings of the word "drive" are JRIV, DRIV, and DRIEV. The first error is common among young children who have not yet had much exposure to conventional orthography. In diagnostic software, this error is assigned the value of "1." The second error, still evidencing a student

functioning at a "letter-name" stage, is nevertheless more advanced and does show some exposure to conventional orthography. It is assigned the value of "2." The third error is characteristic of a student who is becoming sensitive to the "pattern" principle of English spelling; it is assigned a value of "3." This type of analysis affords not only a general placement for instruction but specific information relating to particular areas of slower development. This word knowledge diagnostic program will be incorporated later with a diagnostic comprehension program. Some promising interfaces between word knowledge and reading level are already evident: for example, students who are spelling at the transitional level are usually reading orally in a more natural manner in contrast to the word-by-word monotone in which they read when they spell words at the "letter-name" stage. Again, spelling reflects the perception of units in words. When students no longer are scanning words left-to-right and letter-by-letter, they are spelling them according to "pattern." This more "wholistic" perception allows reading to be guided by comprehension rather than by a laborious letter-by-letter scan.

Much recent psychological, linguistic, and educational research underscores the fact that learning about words is not simply a matter of memorization. As Invernizzi (1985, p. 13) has noted, this learning "is a consequence of developing cognitive strategies for using linguistic information found in English orthography." Recent investigations of these developing strategies have significant implications for both diagnosis and instruction. Part of the work being pursued at the UNR College of Education is directed toward developing a computer-based diagnostic program of pupils' word knowledge. The followin discussion first presents the rationale and structure of this diagnostic program and, second, the adaptation of this program to a Burroughs B25 microcomputer.

Before examining developmental stages of pupils' conceptualization of words, it is necessary to note three principles according to which English spelling operates:

ALPHABETIC PRINCIPLE:	FAT
PATTERN PRINCIPLE:	FATE
MEANING PRINCIPLE:	SIGN
	SIGNATURE
	INSIGNIA

English spelling is alphabetic in that it often represents words in a left-to-right letter/sound correspondence. Indeed, this is the level at which most children approach the system during beginning literacy. This principle is overshadowed, however, by the following two principles: patterns and meaning.

English spelling is also order according to patterns; these are reflected by the many ways in which short and long vowels are "marked" by silent letters. For example, the "silent" e in fate serves to mark the preceding vowel as long; the silent g in the digraph gh in back serves to mark the preceding vowel as short. The pronunciation of many letter groups depends on the pattern in which they occur; for example, gh may stand for /f/ or for no sound at all when it occurs at the end of words (e.g. laugh or through). At the beginning of words, however, gh can represent only one sound: /g/ as in ghost.

The meaning principle is perhaps the most powerful of the three principles. English spelling tends to retain the meaning of similar words as in the letter sequence S-I-G-N in the words sign, signature and insignia.

Although the pronunciation of the sequence S-I-G-N changes depending on the word in which it occurs, this change is overridden by meaning, which retains the spelling. Words that are related in meaning are often related in spelling as well.

The nature of pupils' spelling errors provides insight into the ways in which words are perceived and conceptualized. Developmental research has identified the following stages of conceptualization:

PREPHONETIC: Prereading children "invent" their spellings composing messages such as the following: BBCUS ("Bye bye, see you soon"). There is no internal analysis of words; letters may represent whole words or in some cases whole phrases.

LETTER NAME: Children at the beginning stage of learning to read analyze spoken language in a linear fashion, matching sounds to letters in a left-to-right, spatial-temporal order. Some examples of invented spellings at this stage are as follows:

FES	(fish)	CHRI	(try)
KAK	(cake)	STIPT	(stomped)
PIT	(pot)	SAT	(set)
JRAS	(dress)		

Although these spellings vary considerably from conventional English spelling, they are logical and the strategies underlying them have been found to occur among children of varying dialects and socio-economic levels.

TRANSITIONAL: Errors at this stage reflect pupils' growing understanding of the patterns within single-syllable words.

Representative errors are:

DRIEV (drive)	RIAK (rake)
SNAIK (snake)	

These errors are characteristic because they demonstrate pupils' attention to the role of "silent" letters in marking the pronunciation of vowels. Rather than conceptualizing words in a strict left-to-right order as they did during the "letter name" stage, pupils are now thinking relationally about word structure; i.e., they are able conceptually to move back and forth within the word. This suggests that they perceive words in their reading according to these patterns rather than scanning them from left-to-right, letter by letter as they did at the letter name stage. This is a critical understanding with regard to English orthography, because it is ordered in part according to these patterns rather than according to a strict phonemic system.

SYLLABLE JUNCTURE AND REDUCED VOWELS: Once pupils conceptualize the spelling of words according to patterns, their errors occur primarily at the juncture of syllables and in the unaccented syllables of polysyllabic words:

SLAMED	(slammed)	CRADIL	(cradle)
STUNING	(stunning)	IRIGATE	(irrigate)
AGRAVATE	(aggravate)	COMPUTITION	(competition)

The "consonant doubling" and "e-drop" principles of English spelling apply not only at the ends of words to which suffixes are added but within words as well; IRIGATE requires two "r's" because (1) two consonants are required to "mark" the preceding short vowel

pattern, and (2) the prefix ir functions as a meaning-unit (bound morpheme), and the spelling retains this morphemic unit identity. As students come to understand how meaning functions in the spelling system, these types of errors can be remediated but, perhaps more importantly, vocabulary can be extended and elaborated using the spelling system as a base.

As mentioned above, this developmental progression of students' understanding of word structure has been adapted to the Burroughs B25 microcomputer. While they are seated at a terminal, students are administered a spelling inventory on a cassette to determine their spelling instructional level (criteria are 90-100% correct--Independent; 70-89%--Instructional; 0-69%--Frustrational). Their spellings are typed into the computer which tabulates their instructional level. This level is then further analyzed to determine error types and confirm the level at which word study may be most profitably undertaken. (The issue of spelling with pen and paper rather than searching for the desired letters on the keyboard will be explored in pilot studies. It may be more valid, for example, to have students spell as they are accustomed and then to type in their spellings for analysis since optical scanners become more sophisticated and sensitive).

The words to be spelled in this basic reading program are based on extensive analyses of words in the speaking, listening, and writing vocabularies of first through twelfth-grade students (Henderson & Templeton, 1986; Schlagal, 1982). The program for error analysis at the instructional level is being programmed to assign errors to specific categories. Possible errors that are programmed into the computer

are selected based on errors most likely to occur at these levels. In other words, the computer has a "lexicon" of misspellings. To illustrate, common misspellings of the word "drive" are JRIV, DRIV, and DRIEV. The first error is common among young children who have not yet had much exposure to conventional orthography; it is assigned the value "1." The second error, still evidencing a student functioning at the *letter name* stage, is nevertheless more advanced and does evidence some exposure to conventional orthography; it is assigned the value "2." The third error is characteristic of a student who is becoming sensitive to the pattern principle of English spelling; it would be assigned a value of "3." This type of analysis should afford not only a general placement for instruction but specifics as to particular areas of slower development.

The six stages for word analysis are the following:

1 = Syllabic
2 = Prephonetic
3 = Letter-Name
4 = Correct Vowel; Incorrect Form
5 = Transitional
6 = Correct

The first grade word program has been pilot tested at the Early Learning Center (a combined 1st-, 2nd-, and 3rd-grade experimental classroom at the UNR College of Education. It consists of a program called "ReadingDiagnosis.Bas" (written in BASIC), which outputs a report to a printer. The words to be spelled are recorded on an audiocassette player for simultaneous playback with the computer. All students were administered the first grade list of words on a Burroughs B25 computer. Their performance in this mode was compared to their performance on the same words in a paper-and-pencil mode given two weeks previously. There was no significant difference between the performances. A subsidiary question of this study,

therefore, is tentatively answered: the ability to encode words in a visual format may be validly assessed by this computer program.

Considerable information was obtained with regard to the manageability of the program. One student accidentally hit the "Finish" button and the screen of course cleared—a rather disconcerting phenomenon for this particular first grade child. Subsequently, each student was told to "be careful" about where he/she placed fingers or hands during the session at the keyboard.

Minor adjustments that need to be made in the program include rewording changes in categories on the summary sheet printout that is available to the teacher as well as a category for total number of errors. The value of current programming is that the program will allow for the inclusion of word lists at subsequent grade levels. In addition, error types will need to be added to the "lexicon" of the program.

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